| | A | B | C | D | E | F | G |
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| 1 | **Title** | **Background** | **Justification for Space Flight & Experiment Description** | **Flight Requirements** | | | |
| 2 | | | | **Orbit** | **Altitude** | **Inclination** | **Correlative Environment Measurements** |
| 3 | Single event transients in deep sub-micron microcircuits | Errors due to single event transients (SETs) arising from particle strikes in the combinational logic segments of deep sub-micron microcircuits need to be quantified in order to evaluate hardening options. Ground test results are available, but space data are needed because the space environment cannot be | A variety of orbits should be used, because SETs may arise from nuclear interactions involving protons and high altitude neutrons. Components of the space experiment are a high frequency clock that has a high degree of upset immunity and data telemetry. | High GCR fluence region | High GCR fluence region preferred | Probably a highly elliptical orbit would be best. | Total ionizing dose (Galactic cosmic rays (GRC), proton, neutron fluence) |
| 4 | High-speed analog-to-digital converters (ADCs) | Many space programs need ADCs with high speed and wide band widths. Many new devices have been shown to be sensitive to multi-event upsets. They need to be space qualified to understand how to perform risk mitigation in the | Carry out a space experiment to characterize the performance of the silicon ADCs. | HEO | HEO | HEO | Particle Flux |
| 5 | Neural network computing | For reliable operation in a space particle environment, computing systems using fuzzy-logic, neural net concepts have been proposed because they can adapt to environments where single event effects are prevalent. A pattern/signal recognition experiment with TIMA (France) as a follow-on to one on Microelectronics and Photonics Testbed (MPTB) to improve the concepts. | Perform a pattern/signal recognition experiment in space to characterize the performance and identify areas for design improvements so that reliable computing in a HEO can be obtained. | HEO | HEO | HEO | Particle spectra |
| 6 | Single event upsets (SEUs) in combinational and sequential logic | SEUs in logic are different from SEUs in storage elements. No space data are available to characterize SEUs in logic. | A space experiment is proposed to fly and verify the performance of high-speed logic in an environment where SEUs are expected to occur for SEU-soft devices. Data will be used to improve the performance prediction models for the high-speed logic. | HEO | HEO | HEO | Particle spectra |
| 7 | Enhanced low dose radiation sensitivity (ELDRS) | ELDRS has been seen in space on the Microelectronics and Photonics Testbed (MPTB) and in ground testing, but its rate and mitigation or accommodation techniques have not been validated. Several hardness assurance schemes are being developed. | Perform a space experiment to measure the rates of ELDRS in a variety of linear bipolar technologies and to develop accommodation and/or mitigation techniques. Use the data to validate a cost-effective screening technique for ELDRS on the ground. | HEO | HEO | HEO | Dose & dose rate |
| 8 | Mitigation techniques for single event upsets (SEUs) in high density commercial off-the-shelf | Some electronics such as field programmable gate arrays and GaAs heterobipolar transistors have high sensitivities to SEUs but provide important capabilities in a mission. The impact of SEUs may be reduced using error mitigation method, but these methods require validation of the ground test methods with | Perform a space experiment to collect data on SEU rates for classes of the high density COTS devices. Use the data to improve the evaluation techniques for mitigation on the ground. | | | | |
| 9 | Predictions of single event effects in digital electronics | The use of digital electronics (and software) in space electronics is increasing due to technological progress and market demands. The new digital electronics include new circuit topologies/families, structures and shrinking feature sizes and introduce new problems such as clock skew control and single event transients. Ground testing to identify rates of errors has been performed but the results have not been correlated with data from the space environment. Data from space are needed, because the space environment cannot be replicated on the ground. | Perform a space experiment to measure the rates of single event effects in digital electronics and correlate the data with ground test results to improve the performance prediction capability. | | | | Total dose/GCR flux |

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| 10 | Performance prediction for microprocessors | Predicting in-space performance of microprocessors and support chips based on ground radiation testing has large uncertainties, because the prediction tools have not been validated with data from space. These uncertainties could be reduced significantly if data from space were available for validation. | Perform a space experiment to quantify the single event effects of several types of microprocessors (e.g., PPC750, G4, Pentium III, Pentium 4) in space as a function of the state of the space environment. Environment measurements at several specific energies may be needed to correlate with ground radiation sources. Use data to validate ground test protocol and a performance prediction model. | GTO, GEO, or beyond | | | Dose, proton flux (14 MeV & total flux) |
| 11 | Accommodation techniques for single event effects at the component & board levels | Several methods for accommodating single event effects at the component and board levels have been developed. They include triple modular redundancy using commercial microprocessors to accommodate single event effects and packaging of “plastic parts” for space applications. These | Perform a space experiment to quantify the reduction in single event effects from accommodation and mitigation techniques that could be used at the component and board levels. Correlate the results with space environment measurements and use the data to validate performance prediction | LEO through GTO | | | |
| 12 | Ferroelectrics Memories | Ferroelectrics memories are non-volatile memories with non-destructive readouts. The Navy is developing this technology, because it has potential for becoming the critical low-power and radiation-tolerant memory component in some devices with small sizes and low masses. This technology requires | Perform a space experiment to quantify the performance of the ferroelectric memories. Correlate the performance data with correlative environment data, and use the results to validate a performance prediction tool. | LEO through GTO | | | |
| 13 | Radiation effects of analog and mixed-signal systems | Complex mixed signal systems are becoming increasing common. Most of these systems make use of bipolar junction transistors (BJTs) for references, power stage drivers, etc. However, the radiation effects of BJTs are not well understood and show dependencies on dose rate. Space experiments to quantify the behavior of BJTs as a function of solar activity would be beneficial, both in both designing new mixed-mode systems and using commercial off-the-shelf technology better in | Perform a space experiment to quantify the performance of analog and mixed-signal systems. Correlate the performance data with correlative environment data, and use the results to validate a performance prediction tool. Components of the experiment are a simple digital input/output interface and power. | LEO through GTO | | | Dose, temperature, & flux |
| 14 | High speed optical modulators | High-speed optical modulators are needed for electrical-to-optical conversion in next generation transmit/receive modules. However, their performance in the space radiation environment has not been characterized and thus a ground test protocol has | Perform a space experiment to characterize the performance of high-speed optical modulators in the space environment. Use the data to validate a ground test protocol. | GTO | Through belts | TBD | TBD |
| 15 | Radiation effects on commercial power components | With the push to use off-the-shelf components, more evaluations of the radiation effects and the reliability of existing and emerging DC-to-DC converter technologies & vendors are needed. | Perform a space experiment to characterize the performance of commercial power components in the space environment. Use the data to validate a ground test protocol. Experiment components should include a 28 volt power source and | GEO | | | Thermal, dosimetry |
| 16 | Impact of solar variability on SiGe-based microelectronics | High speed SiGe technology shows promise for space applications. Advantages include improved noise and power performance for high-speed digital circuits. Existing data from space show that existing models for predicting single event upset rates may not be applicable. Researches are working to develop these new/revised models, which need to be validated | Perform a space experiment to characterize the performance of SiGe-based microelectronics in the space environment. Use the data to validate a ground test protocol. | Proton and/or heavy ion environment | | | |
| 17 | Impact of solar variability on optocouplers | Components contained in optocouplers shows significant sensitivity to the space radiation environment. This sensitivity can appear as parametric shifts and/or single event transients. Recent ground testing has lead to the development of new models for predicting these effects. In order to insure reliable insertion of these technologies, these models need to be | Perform a space experiment to characterize the performance of optocouplers in the space environment. Use the data to validate a ground test protocol. | Proton and/or heavy ion environment | | | |